Evaluation of the Effects of Tank 50H Solids on Dissolved Uranium, Plutonium and Neptunium.

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SUMMARY

We examined the effects of contacting a simulated salt solution spiked with uranium, plutonium and neptunium with Tank 50H solids. The composite Tank 50H solids used in this study contained 0.365 ± 0.030 mg uranium per gram and 350 ± 9.0 mg oxalate anion per gram of Tank 50H solids. General findings from the study included the following:

- There is no evidence for interaction between Tank 50H solids and uranium from the spiked salt solution.
    -Lack of uranium removal may reflect prior removal of uranium.
- There is evidence for interaction between Tank 50H solids with plutonium and neptunium as evidenced by loss of these two actinides from the salt solution.

- The amount of plutonium and neptunium lost from solution increased with an increase in the quantity of Tank 50H solids for a fixed simulant volume.

- The removal of plutonium and neptunium fit typical sorption isotherms allowing development of loading curves for estimating maximum solids loading.

- The maximum loading capacities for plutonium and neptunium in the simulants are, respectively, 2.01 and 4.48 µg per gram of Tank 50H solids.

- The oxalate in the Tank 50H solids is not directly responsible for the loss of plutonium and neptunium from the salt solution. We attribute the removal of plutonium and neptunium to other minor components of the Tank 50H solids. We recommend additional testing to identify the component responsible for the plutonium and neptunium removal.

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1.0   INTRODUCTION

Tank 50H is scheduled to return to HLW Tank Farm service and receive salt supernate solutions for feed to the Saltstone Facility. Camera inspections in Tank 50H recently revealed two large mounds ("North" and "south" mounds) of solid material, one in the vicinity of the B5 Riser Transfer Pump and the other on the opposite side of the tank[i]. Estimates put the total volume of solids at approximately 61,000 gallons[ii]. These solids present a number of issues upon returning Tank 50H to HLW service. The sample analysis of Tank 50H solids indicated the presence of a significant fraction of sodium oxalate (42.5 wt %) in the north mound solids[iii].

 One option under consideration allows keeping the solids in Tank 50H and bringing low-curie salt solution, as planned, into the tank before sending on to Saltstone. An issue with this option is what affect, if any, the oxalate-rich solids will have on the dissolved uranium and other actinides in the incoming salt solutions. The sodium oxalate in the solids may dissolve and bring about the precipitation and accumulation of any actinides such as uranium and plutonium. Since SRS wastes frequently contain enriched uranium and weapon-grade plutonium, accumulation of the uranium and plutonium in a solid phase is a possible criticality safety concern.

The original objective of this study was to determine if uranium precipitates upon contact of the Tank 50H mound solids with supernates containing uranium. However, during the initial test runs and characterizations for uranium, we found that other actinides (plutonium and neptunium), originally not considered as part of the test matrix, were not fully accounted for in the final mass balance in the simulant filtrates. Hence, we expanded the scope of the tests to include both plutonium and neptunium as well.

2.0   EXPERIMENTAL

2.10   Approach

The experimental plan called for the examination of the possibilities for actinide (uranium, and plutonium neptunium) precipitation or accumulation in the presence of Tank 50H solids in a 5.6 molar sodium salt solution (spiked with near saturation levels of uranium and plutonium) and a decontaminated waste solution prepared for earlier testing as a composite of supernate samples from Tank 44F and Tank 37H. The composition of these two solutions is comparable to that expected to pass through the Tank 50H in the near future in support of the low-curie salt program and over the longer term from the Salt Waste Processing Facility.

We performed all tests at 25 ± 1 °C in capped 150-ml polypropylene. In each test, we contacted an average of $5.012 \pm .015$ grams of the Tank 50H solids with varying amounts of either the 5.6 molar sodium salt solution (identified as SSS) or the decontaminated Tank 37K/44F composite waste solution (identified as DSS)[iv] that had been spiked with additional uranium, plutonium and neptunium. The compositions of the solutions are summarized in Table 1 and 2. Prior to use in these tests, the DSS material had been used in three separate demonstrations: (1) strontium/actinide removal by monosodium titanate followed by caustic side solvent extraction for cesium removal, (2) large laboratory-scale

test of strontium/actinide removal by monosodium titanate and (3) large laboratory-scale test of strontium/actinide removal by permanganate treatment.

One of the liquid-to-solid ratios used in these experiments is based on current estimates of solids in Tank 50H (61,000 gallons) and estimated quantity of supernate (300,000 gallons) derived from the dissolution of 100,000 gallons of saltcake from Tank 41H. The calculated liquid-to-solids ratio (300,000/61,000) for the test is 5:1. We also examined liquid-to-solid ratios of 3:1 and 10:1. Because of the limited quantity of Tank 50H solids, only the intermediate liquid-to-solid ratio of 5:1 was performed in duplicate. In addition to the tests with Tank 50H solids, two tests featured no added solids. These two tests served as controls and allow determination of possible cross contamination in samples.

Tank 50H solids (5.012 ± 0.015 g) were put into each polypropylene bottle and the required volume of solution (SSS and DSS) was introduced to give the desired liquid-to-solid ratios. We performed a total of ten tests, five with SSS and five with DSS solutions.

The ten test bottles were put in an orbital shaker-water bath already equilibrated at 25 ± 1 °C. We set the orbital shaker rate at 200 rpm. We sampled the test mixture after 24, 168, 336 and 504 hours of contact and filtered each sample through a 0.45-micron nylon syringe filter disc to remove undissolved solids. We volumetrically acidified the filtrate with nitric acid and determined the actinide concentrations by inductively coupled plasma mass spectrometry (ICP-MS).

2.20   Screening Tests

Prior to acquiring of Tank 50H solids for these actinide tests, preliminary screening test were performed with sodium oxalate, which is a major constituent (42.5 wt %) of the Tank 50H solids isolated from the north mound of Tank 50H. In the screening test, we contacted the SSS simulant with reagent grade sodium oxalate at a volume ratio of 12:1. We derived this ratio by taking the 5:1 ratio from above and correcting for sodium oxalate content in the solids (42.5 WT %) and assuming that the sodium oxalate and other Tank 50H solids have the same solid densities. Agitation in this test was provided by a magnetic stirrer and a Teflon coated magnetic stirring bar inserted into the test mixture.

Table I.   Synthetic Salt Solution (SSS) Composition.

Component	Target concentration	Units
Total Na	5.60	M
Free NaOH	1.33 E+00	M
$NaNO_3$	2.60E+00	M
$NaNO_2$	1.64E-01	M
Na_2SO_4	5.21E-01	M
Na_2CO_3	2.60E-02	M
$NaAl(OH)_4$	4.29E-01	M
Total U	13.65 $\pm$1	mg/L
Total Pu	275 $\pm$ 20	μg/L
Np-237	650 $\pm$ 60	μg/L

Table II.   Decontaminated Salt Solution (DSS) Composition (ref. iv)

Component	Concentration	Units
Na	9.16	M
K	0.06	M
Ag	9.46	mg/L
Ba	2.82	mg/L
Ca	19.92	mg/L
Cd	2.16	mg/L
Cr	64	mg/L
Mo	78	mg/L
Free OH^-	6.81	M
NO_3-	0.95	M
NO_2^-	0.68	M
AlO_2^-	0.30	M
SO_4^{2-}	0.07	M
CO_3^{2-}	0.11	M
PO_4^{3-}	0.01	M
Total Uranium	19 $\pm$ 1	mg/L
Total Pu	52 $\pm$ 5	μg/L

2.30 Characterization of Tank 50H Solids

The moisture content of Tank 50H solids was determined by exposing known amounts in a negative pressure hood with constant airflow and a desiccator for several weeks. The samples were weighed every other day until constant weight. The average moisture content obtained for tank 50H solids measured 13.4 ± 0.6 weight percent.

Oxalate anion concentration in Tank 50H solids was determined by two methods: direct acid digestion of the solid and analysis of the filtrate by ion chromatography (IC) and distilled water leaching of the solids over night and analysis of the filtrate by IC.

Oxalate concentration measured 0.3565 ± 0.0344 gram oxalate per gram of Tank 50H solids from the acid digestions and 0.3431 ± 0.047 gram oxalate per gram of Tank 50H solids from the distilled water leachates. These results indicate that more than 95% of the oxalate in the composite Tank 50H solids dissolved in water.

We also analyzed the filtered water leachates for actinide content by ICP-MS.

The uranium concentration measured 0.365 ± 0.03 mg uranium per gram of Tank 50H solid. This corresponds to an addition of 1.65 ± 0.35 mg uranium in each test. No plutonium was measured in the Tank 50H solid and only 1.18 E-03 ± 1.15E-04 mg neptunium per gram of Tank 50H solid was measured (see Table III below).

Table III. Major Cations, Anions and Actinides from Distilled Water-Leaches of the Tank 50H Solids.

Cations	First Leachate	Second Leachate	Average	Units	mg/g Tank 50H solids
Al	38.9	39	38.95	mg/L	0.784
B	3.15	3.07	3.11	mg/L	0.063
Ca	0.936	1.1	1.018	mg/L	0.020
Ce	0.397	0.481	0.439	mg/L	0.009
Cr	0.559	0.556	0.558	mg/L	0.011
Cu	0.451	0.446	0.449	mg/L	0.009
Fe	0.333	0.321	0.327	mg/L	0.007
Mg	0.196	0.193	0.195	mg/L	0.004
Na	14100	14000	14050	mg/L	282.7
P	7.6	7.66	7.63	mg/L	0.154
Si	0.3632	0.609	0.620	mg/L	0.012
Sn	0.658	0.727	0.693	mg/L	0.014
Sr	0.221	0.267	0.244	mg/L	0.005
Total U	0.344	0.387	0.365 ± 0.030	mg U/g Tank 50H solids	0.365 ± 0.030
Np-237	1.07E-03	1.28E-03	1.18E-03 $\pm$ 1.5 E-04	mg Np/g Tank 50H solids	1.18E-03 $\pm$ 1.5 E-04
Oxalate anion	343	356	350 ± 9	mg /g Tank 50H solids	350 ± 9

3.0   RESULTS and DISCUSSION

3.10   Behavior of Uranium upon Contact of Salt Solutions with Solid Sodium Oxalate
       and Tank 50H Solids

Figure 1(inserts A, B and C) shows overlay uranium concentration-time profiles for tests in which we contacted the SSS and DSS solutions with sodium oxalate solids and Tank 50H solids. Insert A is the uranium profile for the test with SSS and solid sodium oxalate. The average uranium concentration for the control test without sodium oxalate solids, labeled as untreated, measured 13.5 ± 2.1 mg/L. For the tests with sodium oxalate solids (labeled treated), the uranium concentration averaged 12.2 ± 0.67 mg/L. (see appendix A, tables A1 for a complete listing of the measured uranium concentrations).

Insert B in Figure 1 shows the uranium concentration-time profile plots for the SSS solution with (treated) and without (untreated) Tank 50H solids. The uranium concentration for the test with Tank 50H solids averaged 14.43 ± 0.51 mg/L, versus that without solids at 14.62 ± 0.58 mg/L. It is worth noting that Tank 50H solids (5.012 ± 0.015 g) used in each test may contribute as much as 1.65 mg uranium to the over all uranium concentration (see characterization of Tank 50H solids). Thus we conclude that Tank 50H solids do not precipitate uranium from the SSS solution.

Insert C in Figure 1 shows a similar uranium concentration-time profile plot for contact of the DSS solution with Tank 50H solids (see Appendix A, Table A1 for experimental data). In this test the uranium concentration for the untreated sample averaged 18.14 ± 0.63 mg/L compared to the treated sample of 18.40 ± 0.34 mg/L. Again, there is statistically no difference in the uranium concentrations between the untreated and treated tests with Tank 50H solids; indicating no precipitation of uranium.

Based on these findings with the SSS and DSS solutions in contact with sodium oxalate and Tank 50H solids, we conclude that neither material interacts with the uranium in solution to produce a uranium precipitate. This lack of interaction between Tank 50H solids and the SSS and DSS solutions may be due to relatively high uranium concentration in the solids (0.36 mg/g), which serves to limit the sorption of uranium from solution onto the solids.

3.20   Behavior of Plutonium and Neptunium upon Contact of Salt Solutions with Solid
       Sodium Oxalate and Tank 50H solids.

Figure 2 (inserts D, E and F) shows overlay plutonium concentration-time profiles tests in which we contacted the SSS and DSS solutions with sodium oxalate solids and simulant tests with Tank 50H solids. Insert D is the plutonium profile for tests with the SSS solution and sodium oxalate solids. The average plutonium concentration for the control test without sodium oxalate solids (labeled untreated) measured 276 ± 59 μg/L. For the tests with sodium oxalate solids (labeled treated) the average plutonium measured was 264 ± 31.1μg/L (see Appendix A, Table A2 for complete listing of plutonium data). The

average concentrations are not statistically different. Thus we conclude that contact of the SSS solution with sodium oxalate does not precipitate plutonium.

A: Uranium in SSS with Sodium oxalate solids

B: Uranium in SSS with Tank 50H solids.

C: Uranium in DSS with Tank 50H solids.

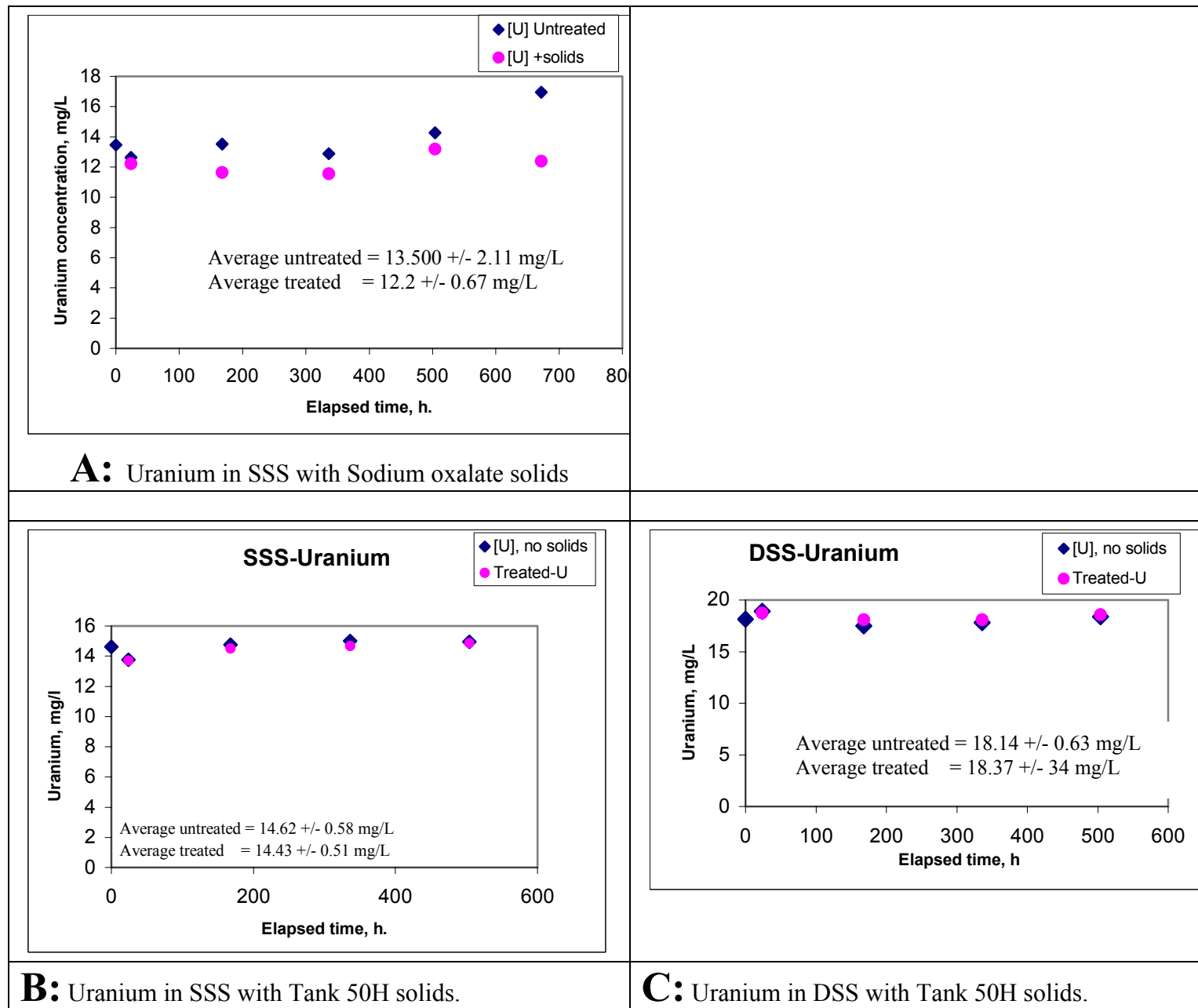**Figure 1. Uranium:** Tests with oxalate solids in SSS (A) and Tank 50H solids in SSS and DSS solutions (B and C).

D: Plutonium in SSS with Sodium oxalate solids

E: Plutonium in SSS with Tank 50H solids.

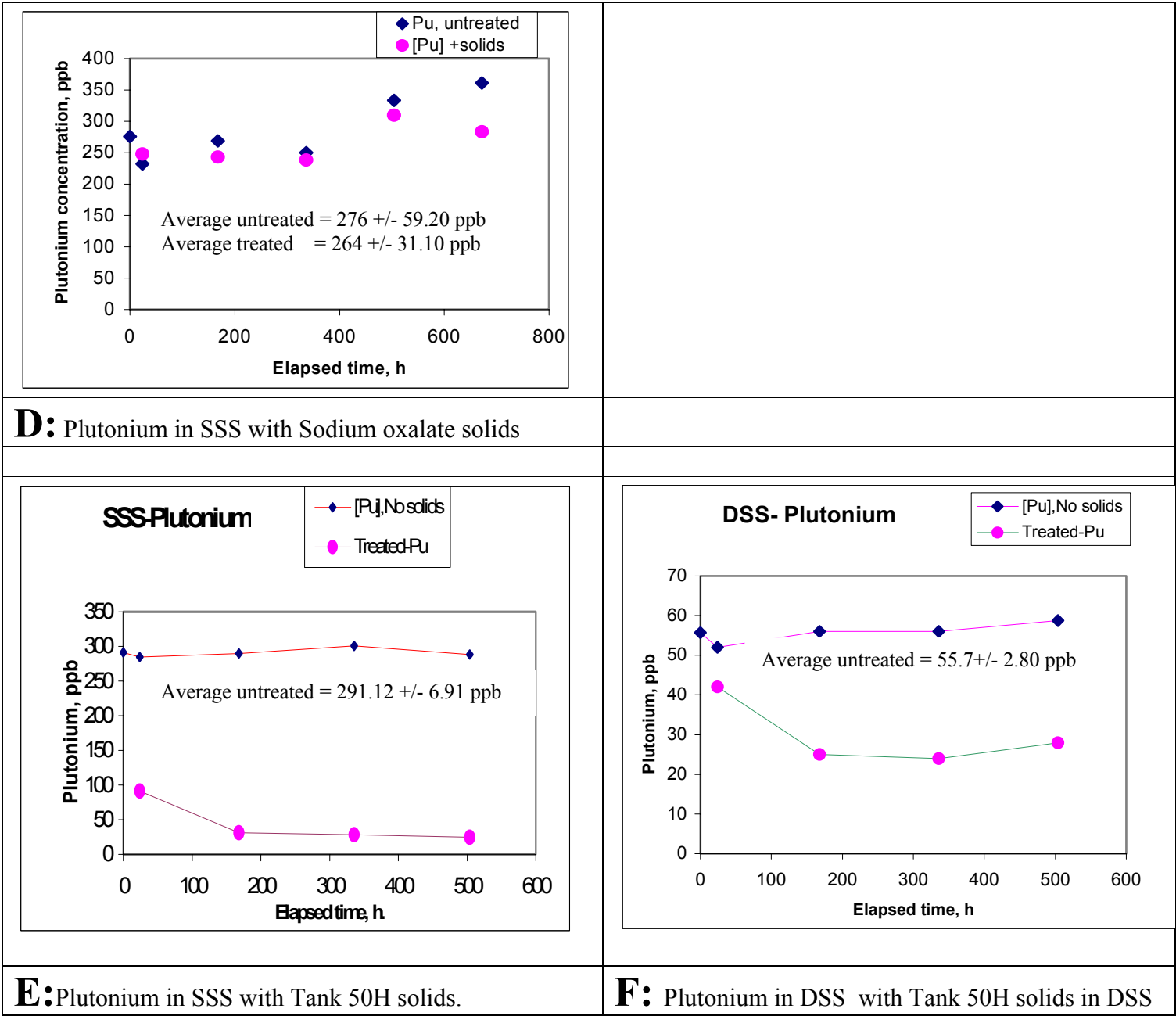**F:** Plutonium in DSS with Tank 50H solids in DSS

Figure 2. Plutonium: Oxalate solids in SSS solution (D), Tank 50H solids in SSS
and DSS solutions (E and F).

Insert E in Figure 2 shows the overlay plutonium concentration-time profile plots for the contact of SSS solution with Tank 50H solids (treated) and the SSS solution without solids (untreated). Within the first 24 hours of exposing the SSS solution to Tank 50H solids, we observed the removal of over 65 % of the plutonium (see Appendix A, Table A2 for experimental data). Plutonium removal increased to more than 90 % after 168 hours of contact.

We also observed plutonium removal upon contact of the DSS solution with Tank 50H solids. The total masses and percent removed were lower in the test with the DSS solution. For example, plutonium removal measured 24 % after 24 hours of contact and 55 % after 168 hours. This is not unexpected given the lower initial plutonium concentration in the DSS solution (55.7 ± 2.8 µg/L) compared to that in the SSS solution (276 ± 59 µg/L).

Insert G in Figure 3 shows the overlay neptunium concentration-time profiles for the test with the SSS solution and sodium oxalate solids. The average untreated neptunium concentration for the untreated solution measured 572 ± 56 µg/L compared to that of the treated solution at $536 \pm$ µg/L. Again, there is no statistical difference in neptunium concentrations between the untreated SSS solution and that contacted with sodium oxalic solids. Hence we conclude that there is no loss of neptunium in the presence of sodium oxalate solids.

Insert H in Figure 3 shows the overlay neptunium concentration-time profiles plot for the SSS solution with and without the addition of the Tank 50H solids. Within the first 24 hours of contact with the Tank 50H solids, we observed the loss of over 60 % of the neptunium (see Appendix A, Table A3 for experimental data). After 168 hours of contact, we measured more than 77 % removal of the neptunium. Thus, we conclude that the tank 50H solids react with both plutonium and neptunium in the SSS solution. The reaction must not occur with the sodium oxalate that is present in the Tank 50H solids since no reaction is observed between the SSS solution and reagent grade sodium oxalate.

The mechanism responsible for the plutonium and neptunium removal has not been identified, but it is conjectured to be actinide reduction of some sort followed by precipitation and/or sorption. Additional testing would be required to identify the specific removal mechanism and determine how to mitigate.

G: Neptunium in SSS with Sodium oxalate solids

H: Neptunium in SSS with Tank 50H solids.
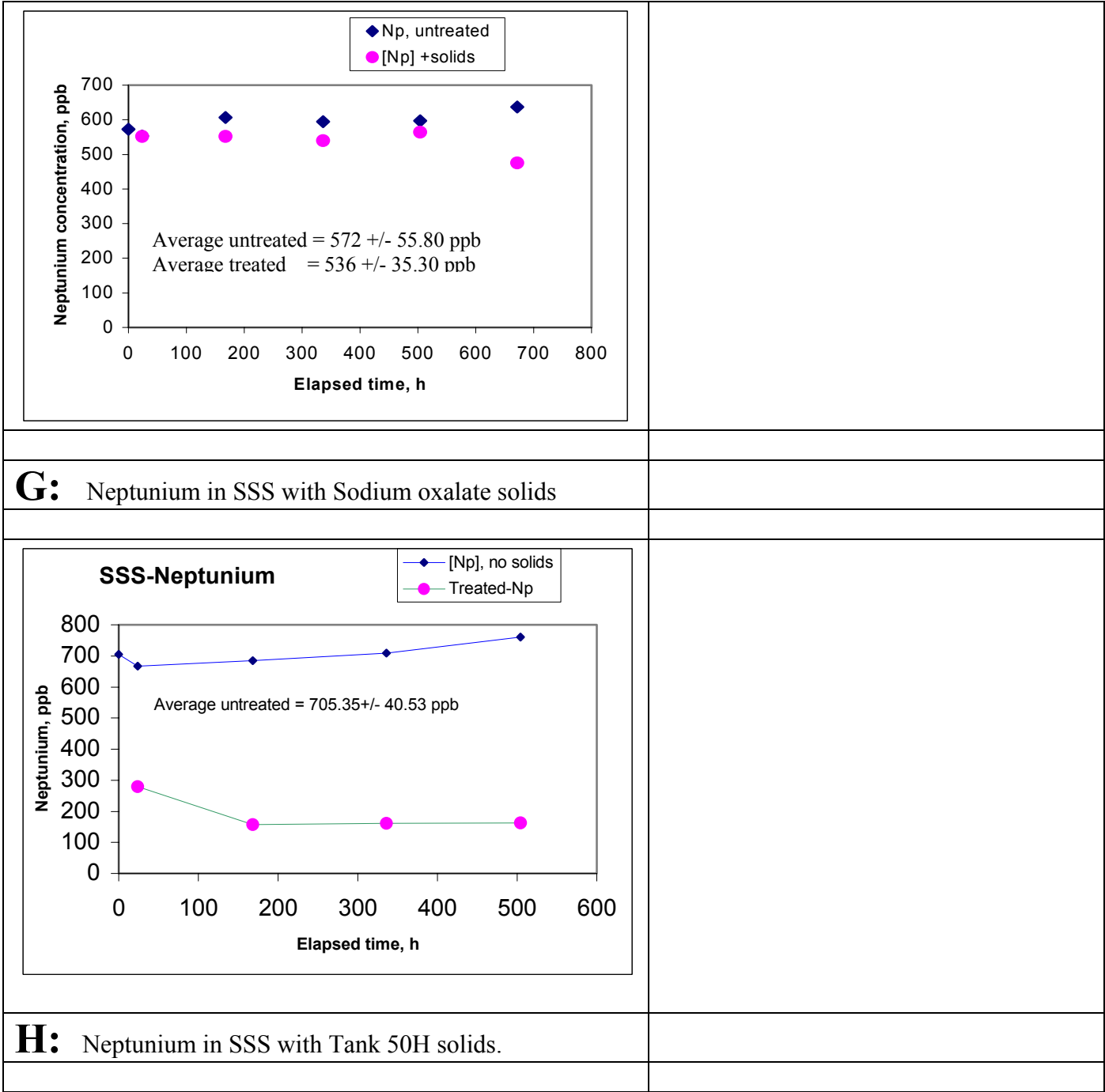
Figure 3. Neptunium: Oxalate solids in SSS solutiont (G), Tank 50 H solids in SSS (H).

I: 24 hours elapsed time actinide concentration changes with Liquid-to-solid for SSS

J: 24 hours elapsed time actinide concentration changes with Liquid-to-solid for DSS
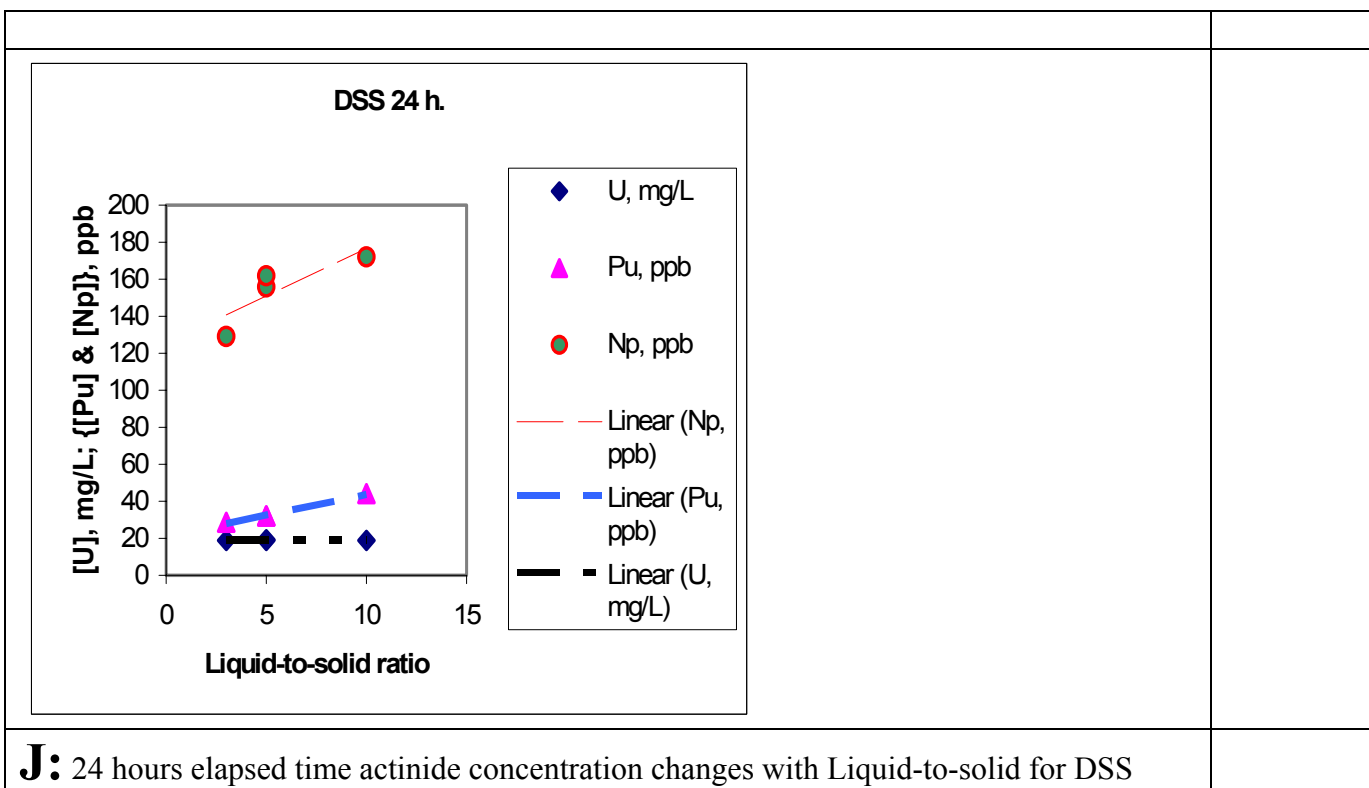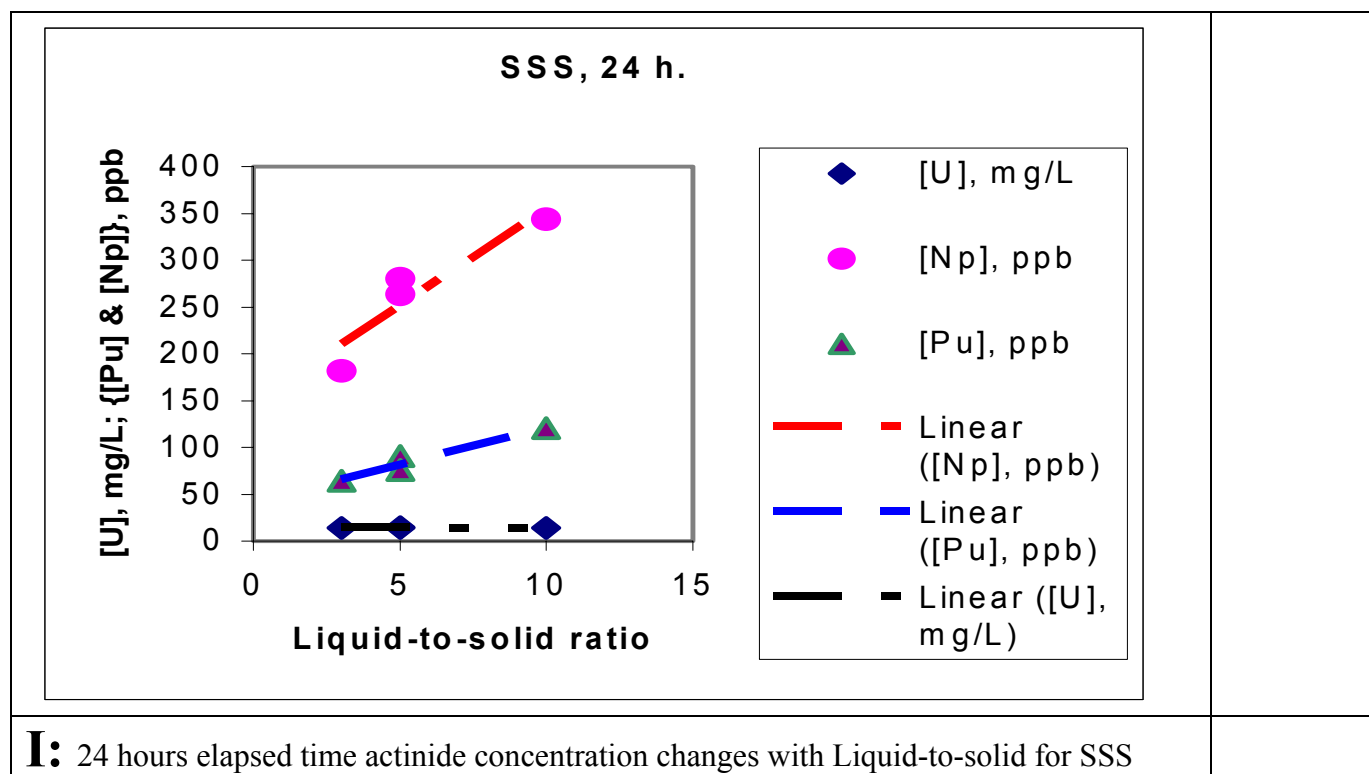
Figure 4. Actinide concentration in SSS and DSS solutions versus Liquid-to-solid ratios.

3.30   Actinide concentration changes with Liquid-to-solid ratios in the presence of Tank 50H solids.

Figure 4 shows overlay plots the 24 hour-elapsed time actinide concentration changes as a function of the liquid-to-solid ratios for the tests with SSS and DSS solutions in contact with Tank 50H solids. In both overlay plots, as the liquid-to-solid ratios decrease (increase in Tank 50H solid fraction) the amount of plutonium and neptunium precipitated or lost from the liquid phase increased. This behavior is consistent with typical sorption suggesting that plutonium and neptunium are sorbing onto one or more of the components in the Tank 50H solids. We observed this same behavior at the other sampling times (168, 336 and 504 hours). Appendix B provides the experimental data and plots for the 168, 336 and 504 hours samples. Note that we observed no loss in uranium in any of the tests with varying liquid-to-solid ratios.

3.40   Plutonium and Neptunium Loading Curves with Tank 50H solids.

Figure 5, inserts K and L, provide plutonium and neptunium loading curves, respectively, for the Tank 50H solids after 504 hours of exposing Tank 50H solids of contact with the SSS and DSS solutions. Appendix A, Table A4 provides the experimental data. Data for the lower portions of the loading curves are data from the tests with the DSS solutions, whereas the higher loadings are from tests with the SSS solutions. The higher loadings with the SSS solutions result from the higher initial concentrations of plutonium and neptunium in this solution compared to the DSS solution.

The loading curve information is useful in estimating the volume of Tank Farm supernates that can be transferred into the Tank before accumulating significant quantities of plutonium that represent a nuclear criticality safety concern. Conversely, the information could also be used to determine how much of the Tank solids could be left behind and not represent a safety concern due to the accumulation of plutonium. Regression of the data provides the following equations for estimating maximum loading of plutonium and neptunium.

$y = -0.3335x^2 + 65.497x - 1205.9$ for plutonium and
$y = -0.029x^2 + 23.126x$ for neptunium,

where y is loading capacity in units of μg actinide per gram of Tank 50H solids and x is the final actinide concentration in μg/L.

By equating the first derivatives of the above two loading capacity equations to zero and solving for x values, the maximum loading capacities (y-values) for plutonium and Neptunium are, respectively, 2.01 and 4.48 μg per gram of Tank 50H solids.
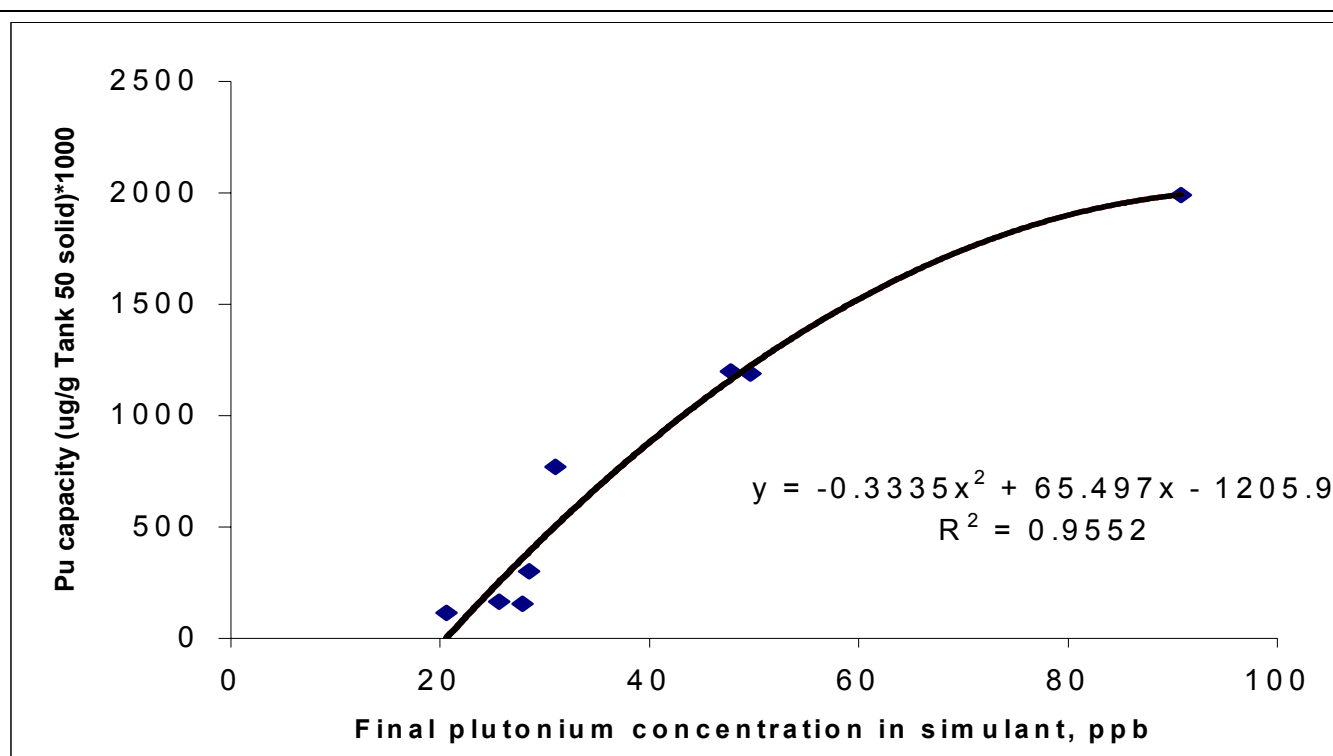
K: Plutonium loading capacity in simulant solution containing Tank 50H Solids after 504 hours.

The chart shows:
- Y-axis: Pu capacity (ug/g Tank 50 solid)*1000, ranging from 0 to 2500
- X-axis: Final plutonium concentration in simulant, ppb, ranging from 0 to 100
- Equation: $y = -0.3335x^2 + 65.497x - 1205.9$
- $R^2 = 0.9552$
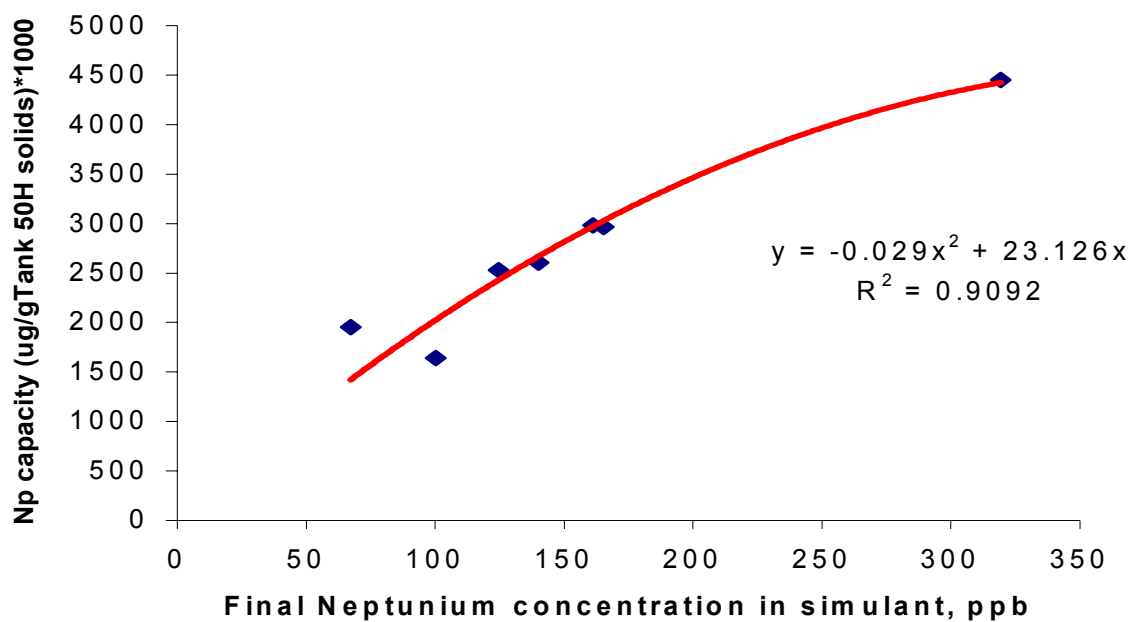
L: Neptunium loading capacity in simulant solution containing Tank 50H Solids after 504 hours.

Figure 5. Plutonium and Neptunium Loading Curves.

4.0   CONCLUSIONS and RECOMMENDATIONS

We conducted a series of tests to evaluate the interaction of sodium oxalate and Tank 50H solids with actinide dissolved in simulated and tank waste solutions. From these tests we conclude the following:

- Greater than 90% of the oxalate in the Tank 50H solids is water soluble,
- There is no interaction between sodium oxalate solids and uranium, plutonium and neptunium dissolved in simulated and tank waste solutions,
- There is no interaction between Tank 50H solids and uranium dissolved in simulated and tank waste solutions,
- There is no evidence of uranium removal upon contact of Tank 50H solids with simulated and tank waste solutions,
  - -Lack of uranium removal may reflect prior removal of uranium.

- Tank 50H solids effectively removed plutonium and neptunium from simulated and tank waste solutions. The mechanism responsible for the plutonium and neptunium removal has not been identified, but it is conjectured to be reduction of some sort followed by precipitation and/or sorption.

- The removal of plutonium and neptunium fit typical sorption isotherms allowing development of loading curves for estimating maximum solids loading.

- The maximum loading capacities for plutonium and neptunium are, respectively, 2.01 and 4.48 μg per gram of Tank 50H solids.

- We recommend that additional tests be conducted to identify the component (s) responsible for the removal of plutonium and neptunium and possibly uranium from the alkaline waste solutions.

5.0   QUALITY ASSURANCE

This study fulfills the activity defined in Task Technical and Quality Assurance Plan: "Evaluation of the Effects of Tank 50H solid on Dissolved Uranium" WSRC-RP-2001-01096, Rev.0, Dec. 13,2001. Data obtained from this study reside as records in WSRC-LB-2001-00179.

6.0   ACKNOWLEDGEMENTS

The authors thank Analytical Development Section personnel, in particular, B. Boyce, M. Malek, R. Ray and J. Hart for performing actinide anion and other metal analyses. We also thank M. S. Blume for assistance in running the experiments.

APPENDIX A

Data for uranium in simulants: SSS containing sodium oxalate, SSS and DSS containing Tank 50H solids.

A1- SSS and DSS uranium data for sodium oxalate and Tank 50H solids

Time, h	[U] Untreated	[U] +solids
0	13.463	
24	12.623	
168	13.509	
336	12.89	
504	14.27	
672	16.94	
24		12.22
168		11.64
336		11.55
504		13.2
672		12.4
Units	mg/L	mg/L

Uranium in SSS with Sodium oxalate solids

Time, h	[U], no solids	Treated-U	Time, h	[U], no solids	Treated-U
0	14.62		0	18.143	
24	13.757		24	18.9	
168	14.765		168	17.472	
336	15		336	17.8	
504	14.94		504	18.4	
24		13.69	24		18.74
168		14.51	168		18.08
336		14.66	336		18.08
504		14.86	504		18.58
Units	mg/L	mg/L	Units	mg/L	mg/L

Uranium in SSS with Tank 50H solids	Uranium in DSS with Tank 50H solids

A2- SSS and DSS plutonium data for sodium oxalate and Tank 50H solids

Time, h	Pu, untreated	[Pu] +solids
0	276	
24	232	
168	269	
336	250	
504	333	
672	361	
24		248
168		243
336		238
504		310
672		283
Units	ppb	ppb

Plutonium in SSS with Sodium oxalate solids

Time, h	[Pu],No solids	Treated-Pu		Time, h	[Pu],No solids	Treated-Pu
0	291.125			0	55.7	
24	285			24	52	
168	290			168	56	
336	301			336	56	
504	288.5			504	58.8	
24		91		24		42
168		31		168		25
336		28		336		24
504		24.4		504		28
Units	ppb	ppb		Units	ppb	ppb

Plutonium in SSS with Tank 50H solids | Plutonium in DSS with Tank 50H solids in

A3- SSS and DSS neptunium data for sodium oxalate and Tank 50H solids

Time, h	Np, untreated	[Np] +solids	
0	572		
24	553		
168	606		
336	594		
504	597		
672	637		
24		552	
168		552	
336		540	
504		564	
672		475	
Units	ppb	ppb	
Neptunium in SSS with Sodium oxalate solids			
Time, h	[Np], no solids	Treated-Np	
0	705.35		
24	667		
168	685		
336	709		
504	760.4		
24		280	
168		157	
336		161	
504		163	
Units	ppb	ppb	
Neptunium in SSS with Tank 50H solids			

A4- Plutonium and Neptunium loading curve Data for SSS and DSS contact with Tank 50H solids.

Pu-Fin. Ppb	ugPu/gTank 50H solid*1000	Np-Fin. Ppb	ug Np/g Tank 50H solid *1000
90.8	1990.737	319.2	4450.362
47.8	1199.04	165.32	2964.19
49.68	1189.205	161.12	2983.918
30.99	771.5099	67.23	1953.146
28.48	300.6743		
25.6	165.8	140	2606.72
27.86	154.52	124.6	2529.81
20.58	114.68	100.11	1639.71
Plutonium loading curve data		Neptunium loading curve data	

APPENDIX B

Overlay plots and experimental data for actinide concentration changes with liquid-to-solid ratios for SSS and DSS contact with Tank 50H solids.

B1-24, 168, 336 and 504 hour-elapsed time overlay plots for SSS in contact with Tank 50H solids.
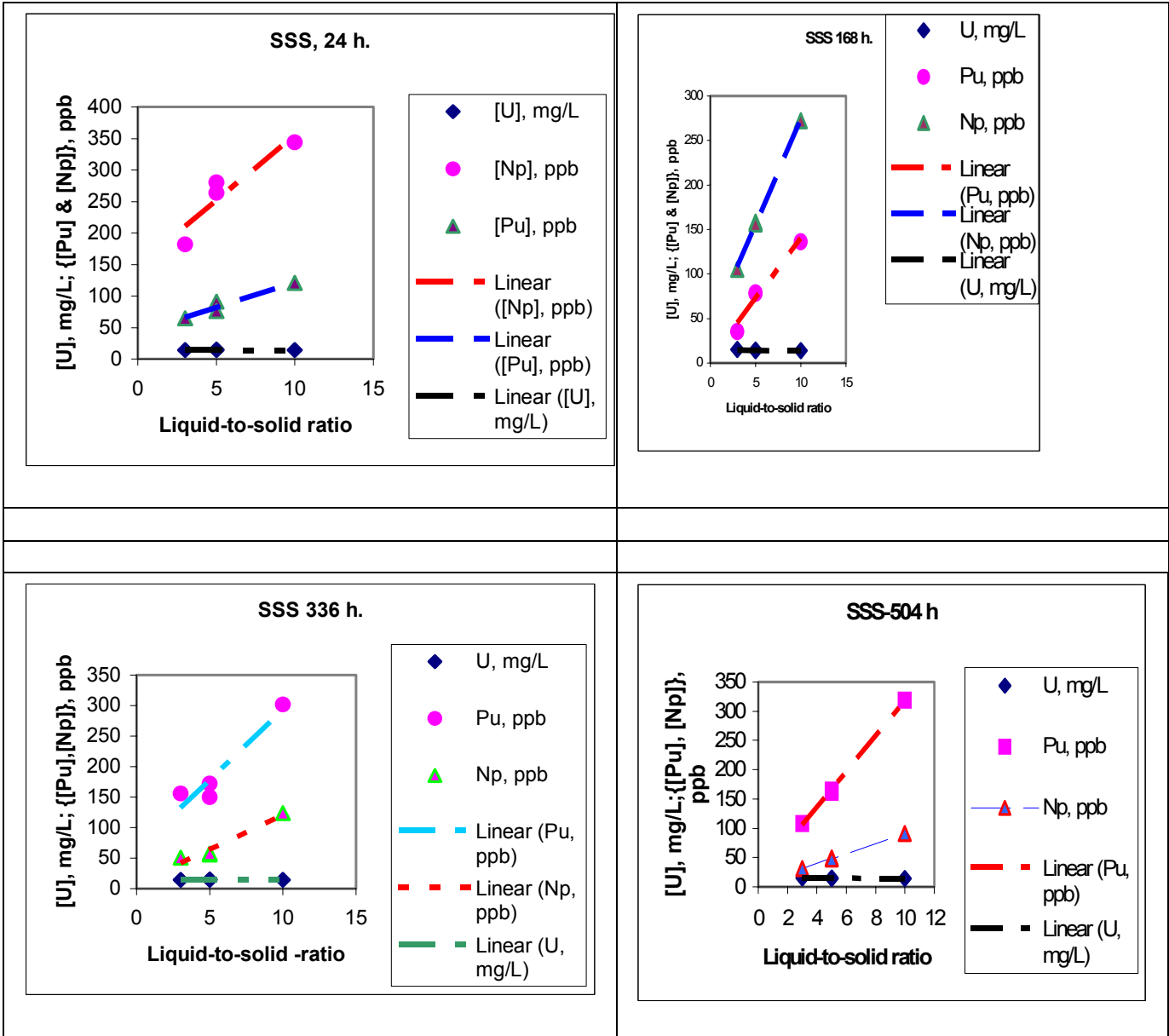
B2-24, 168, 336 and 504 hour-elapsed time data for SSS in contact with Tank 50H solids.

24 hours

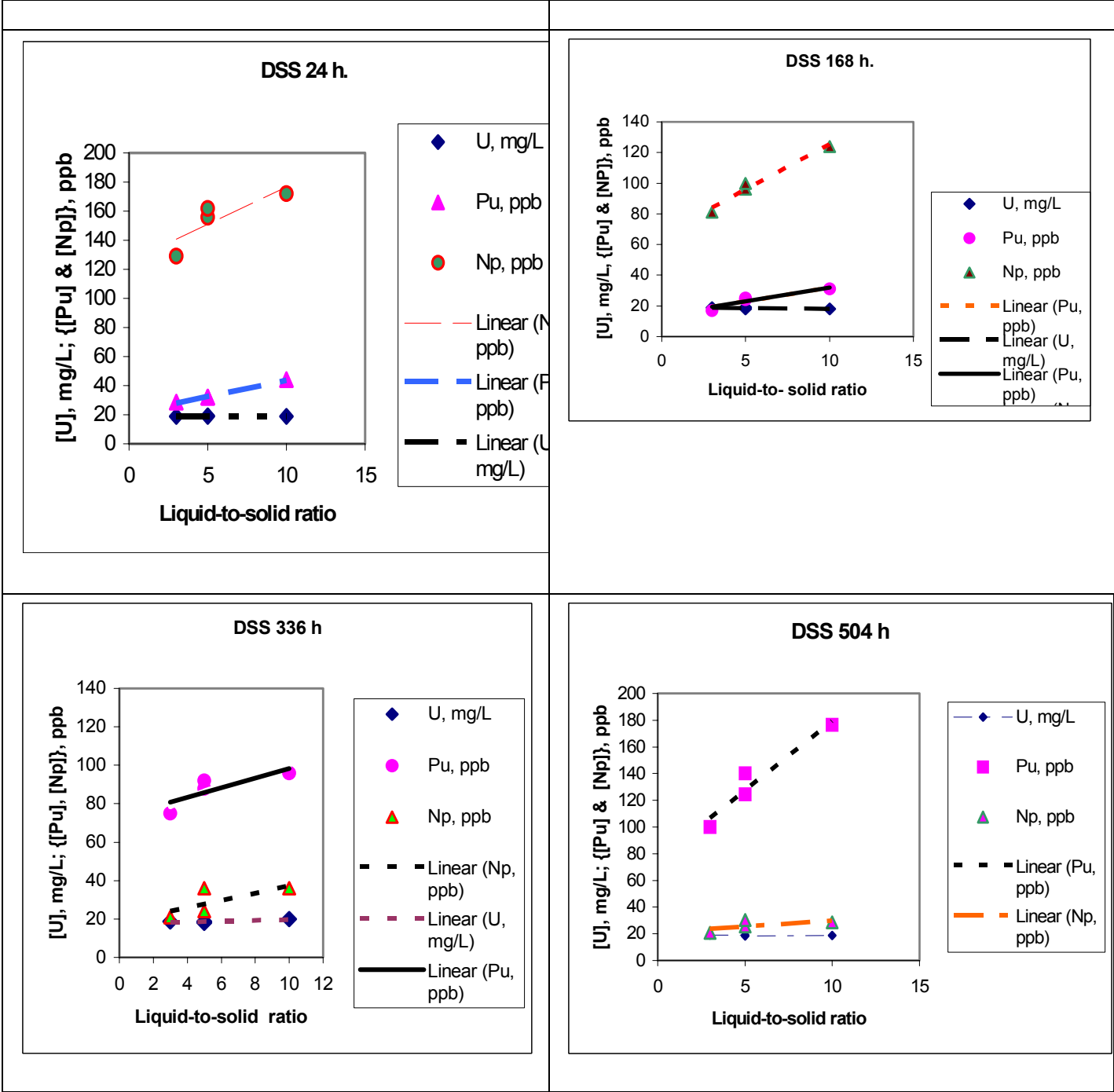| L/S Ratio	[U], mg/L	[Np], ppb	[Pu], ppb
3			64.5
5			91
5			76
10			121
3		181.5	
5		264	
5		280	
10		344	
3	14.41		
5	14.15		
5	14.86		
10	13.67		
Initial [conc]	13.65	650	275

168 hours

L/S Ratio	U, mg/L	Pu, ppb	Np, ppb
3	14.904		
5	14.422		
5	14.168		
10	13.998		
3		35	
5		78	
5		79	
10		136	
3			105
5			158
5			156
10			272
Initial [conc]	13.65	650	275

336 hours

L/S Ratio	U, mg/L	Pu, ppb	Np, ppb
3	14.533		
5	14.352		
5	15.174		
10	14.352		
3		156	
5		150	
5		172	
10		302	
3			51
5			56
5			58
10			124
Initial [conc]	13.65	650	275

504 hours

L/S Ratio	U, mg/L	Pu, ppb	Np, ppb
3	14.86		
5	14.71		
5	14.62		
10	14		
3		108.45	
5		161.12	
5		165.32	
10		318.4	
3			30.99
5			49.68
5			47.8
10			90.8
Initial [conc]	13.65	650	275

B3-24, 168, 336 and 504 hour-elapsed time overlay plots for DSS in contact with Tank 50H solids.

B4-24, 168, 336 and 504 hour-elapsed time data for DSS in contact with Tank 50H solids.

L/S Ratio	U, mg/L	Pu, ppb	Np, ppb
3	18.81		
5	18.74		
5	19.3		
10	18.97		
3		28.5	
5		32	
5		32	
10		44	
3			129
5			156
5			162
10			172
Initial [conc]	19	52	

24 hours

L/S Ratio	U, mg/L	Pu, ppb	Np, ppb
3	18.897		
5	18.984		
5	18.08		
10	17.952		
3		17	
5		25	
5		24	
10		31	
3			81
5			96
5			100
10			124
Initial [conc]	19	52	

168 hours

L/S Ratio	U, mg/L	Pu, ppb	Np, ppb
3	18.836		
5	18.076		
5	18.676		
10	19.845		
3		75	
5		92	
5		**88**	
10		96	
		116	
3			21
5			24
5			36
10			36
Initial [conc]	19		56

336 hours

L/S Ratio	U, mg/L	Pu, ppb	Np, ppb
3	19.21		
5	18.96		
5	18.21		
10	18.58		
3		100.11	
5		124.6	
5		140	
10		176.4	
3			20.58
5			25.6
5			30.12
10			28.48
Initial [conc]	19		56

504 hours

7.0   REFERENCES

[i] Banaszewski, C.D., "Engineering Path Forward HTF-PF-2002-0014: Tank 50H Solids (U)", HLW-STE-2002-00388, October 23,2002.

[ii] Banaszewski, C.D., "Tank 50 Solids Mound Volume Calculation", J-CLC-H-00793, Rev. 0, November 2002.

[iii] Wilmarth, W.R., "Results of Sample Analysis from Solids Removed from Tank 50H", WSRC-TR-2002-00506, November 1,2002.

[iv] S. D. Fink, D. T. Hobbs, M. A. Norato, T. B. Peters and D. D. Walker, "Demonstration of MST and Permanganate Efficiency on Removal of Actinides and Strontium From Savannah River Site High Level Waste," WSRC-TR-2002-00355, January 2003.